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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/918,463	08/01/2001	Yongju Jung	1567.1014	2888

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STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

EXAMINER	
DOVE, TRACY MAE	
ART UNIT	PAPER NUMBER
1745	8

DATE MAILED: 01/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

A-8-8

Office Action Summary	Application No.	Applicant(s)	
	09/918,463	JUNG ET AL.	
	Examiner	Art Unit	
	Tracy Dove	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 October 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-35* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

This Office Action is in response to the communication filed on 10/17/03. Applicant's arguments have been considered, but are not persuasive. Claims 1-35 remain rejected. This Action is made **FINAL**, as necessitated by amendment.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-35 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claims 1, 12, 19 and 33 recite "where the weak polar solvent group is utilized, the mixed organic solvent includes less than 50% by weight of the weak polar solvent", which is not supported by the specification as filed.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-35 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claims recite a mixed organic solvent comprising at least two different solvent groups selected from weak polar solvent, strong polar solvent and lithium protection solvent.

However, the claims are indefinite because the weak polar solvent and the lithium protection solvent may be the same. Specifically, the weak polar solvent may be a cyclic or noncyclic ether compound (claim 2) and the lithium protection solvent may be a saturated or unsaturated ether solvent (claim 4). Thus, an ether compound may be both a weak polar solvent and a lithium protection solvent. The claims are indefinite because a single solvent (no "mixed solvent") can represent "at least two" solvent groups.

Claims 1, 12, 19 and 33 recite "where the weak polar solvent group is utilized, the mixed organic solvent includes less than 50% by weight of the weak polar solvent", which is indefinite because it is unclear if the limitation is part of the claimed invention because the limitation appears to indicate a "situation". Specifically, only if "weak polar solvent group" is selected from the Markush group of the instant claims does the limitation become part of the claimed invention. If one selected "a strong polar solvent group" and "a lithium protection solvent group" for the mixed organic solvents, a "weak polar solvent group" is not required by the claimed invention.

Claim 33 recites "a material in which lithium intercalation reversibly occurs selected from the group consisting of a lithium alloy and a lithium metal", however, these materials do not intercalate lithium. Examiner suggest the claim be amended to recite "a negative active material selected from the group consisting of a material in which lithium intercalation reversibly occurs, a lithium alloy and a lithium metal".

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-33 are rejected under 35 U.S.C. 102(e) as being anticipated by Chu et al., US 6,030,720.

Chu teaches electrolyte solvents for lithium-sulfur batteries. The disclosed solvents include at least one ethoxy repeating unit compound solvent such as a glyme. The solvent may further include a donor solvent and/or an acceptor solvent. The donor solvent may be hexamethylphosphoramide, dimethylsulfoxide, dimethylacetamide or dimethylformamide. The solvents assist in solvation of lithium ions, sulfide and polysulfide anions. See abstract. Claim 5 recites the main solvent is tetraglyme (weak polar solvent of instant claim 5). Claim 8 recites the donor solvent may be at least one of hexamethylphosphoramide, dimethylsulfoxide, dimethylacetamide or dimethylformamide (strong polar solvent of instant claim 6). It should be understood that the electrolyte solvents of this invention may also include other cosolvents which do not necessarily fall into the donor solvent and acceptor solvent classes. Examples of such additional co-solvents include sulfolane (strong polar), tetrahydrofuran (lithium protection solvent of claim 7), dioxolane (lithium protection solvent of claim 7), dialkyl carbonates (weak polar), propylene carbonate (strong polar), ethylene carbonate (strong polar), dimethyl carbonate, diethyl carbonate, butyrolactone (strong polar), dimethoxyethane (weak polar) and combinations of such liquids (col. 14, lines 33-41). Thus, Chu teaches two or more solvents selected from the same group.

The positive electrode includes a sulfur-based material such as elemental sulfur and the negative electrode includes lithium metal (col. 5, line 55-col. 6, line 21). The positive electrode may include an electrically conductive material (col. 8, lines 35-42). The electrolyte may include an electrolyte salt such as trifluoromethanesulfonimide, lithium triflate, lithium perchlorate, $LiPF_6$ and $LiBF_4$ (col. 14, lines 56-67). The protection layer 8 is formed on the negative electrode (Fig. 1 and 2B).

Regarding claims 8-10 and 13-15, Chu teaches that the negative electrode may comprise any metal and polyether electrolytes are known to transport divalent ions such as zinc (col. 20, lines 40-50). The materials for the negative electrode include a lithium alloy. Preferred alloys include lithium aluminum, lithium silicon (Si) and lithium tin alloys. Other metallic electrodes may include aluminum (Al), zinc (Zn), lead (Pb) and their alloys (col. 21, lines 1-9). The positive electrode may include sulfides or polysulfides or the metal or metals found in the negative electrode (col. 5, lines 55-65). The positive electrode may include metal sulfide additives (col. 16, lines 39-65).

Regarding claims 19 and 20, identical solvents will have the same ability to dissolve polysulfides, elemental sulfur and/or lithium polysulfide.

Regarding claims 21 and 22, identical solvents will have the same dielectric coefficients. Chu teaches that a desirable property of both donor and acceptor co-solvents used is a high dielectric constant. Such solvents generally promote dissociation of an ionic solute or a contact ion-pair (col. 14, lines 1-5).

Regarding claim 33, Example 1 teaches elemental sulfur, carbon black and polyethylene oxide in a solution of acetonitrile were mixed to form a slurry. The slurry was applied to a

current collector to form the positive electrode. Figure 1 shows a lithium/liquid electrolyte/sulfur cell 10 having a positive electrode 18 with positive collector 20, a negative electrode 14 with negative collector 12, a separator 16 and a protective layer 8.

Thus the claims are anticipated.

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Claims 1-33 are rejected under 35 U.S.C. 102(e) as being anticipated by Nimon et al., US 6,225,002.

Nimon discloses dioxolane as a protector for lithium (negative)electrodes of lithium-sulfur batteries (title). Battery cells containing dioxolane as an electrolyte co-solvent exhibit improved cycling performance over cells not containing dioxolane (abstract). Figure 9 shows a mixed solvent of tetraglyme (weak polar solvent) and dioxolane (lithium protection solvent). The electrolyte includes a main solvent having the chemical formula shown in col. 3, line 18 and a co-solvent wherein the co-solvent includes dioxolane. The electrolyte may also include an additional co-solvent having a donor number of at least about 13 (col. 3, lines 15-25). The battery includes a sulfur-based positive electrode. Donor solvents (strong polar solvents) are disclosed in col. 7, lines 14-22. The electrolyte may include other co-solvents such as those listed on col. 7, lines 32-41. The lithium salts of the electrolyte are listed in col. 7, lines 42-46.

Note Chu et al., US 6,030,720 is incorporated by reference in Nimon (col. 6, lines 26-29). Chu teaches electrolyte solvents for lithium-sulfur batteries. The disclosed solvents include at least one ethoxy repeating unit compound solvent such as a glyme. The solvent may further include a donor solvent and/or an acceptor solvent. The donor solvent may be hexamethylphosphoramide, dimethylsulfoxide, dimethylacetamide or dimethylformamide. The

solvents assist in solvation of lithium ions, sulfide and polysulfide anions. See abstract. Claim 5 recites the main solvent is tetraglyme (weak polar solvent of instant claim 5). Claim 8 recites the donor solvent may be at least one of hexamethylphosphoramide, dimethylsulfoxide, dimethylacetamide or dimethylformamide (strong polar solvent of instant claim 6). It should be understood that the electrolyte solvents of this invention may also include other cosolvents which do not necessarily fall into the donor solvent and acceptor solvent classes. Examples of such additional co-solvents include sulfolane (strong polar), tetrahydrofuran (lithium protection solvent of claim 7), dioxolane (lithium protection solvent of claim 7), dialkyl carbonates (weak polar), propylene carbonate (strong polar), ethylene carbonate (strong polar), dimethyl carbonate, diethyl carbonate, butyrolactone (strong polar), dimethoxyethane (weak polar) and combinations of such liquids (col. 14, lines 33-41). Chu teaches two or more solvents selected from the same group. The positive electrode includes a sulfur-based material such as elemental sulfur and the negative electrode includes lithium metal (col. 5, line 55-col. 6, line 21). The positive electrode may include an electrically conductive material (col. 8, lines 35-42). The electrolyte may include an electrolyte salt such as trifluoromethanesulfonimide, lithium triflate, lithium perchlorate, $LiPF_6$ and $LiBF_4$ (col. 14, lines 56-67). The protection layer 8 is formed on the negative electrode (Fig. 1 and 2B). Chu teaches that the negative electrode may comprise any metal and polyether electrolytes are known to transport divalent ions such as zinc (col. 20, lines 40-50). The materials for the negative electrode include a lithium alloy. Preferred alloys include lithium aluminum, lithium silicon (Si) and lithium tin alloys. Other metallic electrodes may include aluminum (Al), zinc (Zn), lead (Pb) and their alloys (col. 21, lines 1-9). The positive electrode may include sulfides or polysulfides or the metal or metals found in the

negative electrode (col. 5, lines 55-65). The positive electrode may include metal sulfide additives (col. 16, lines 39-65). Note identical solvents will have the same ability to dissolve polysulfides, elemental sulfur and/or lithium polysulfide. Also note identical solvents will have the same dielectric coefficients. Chu teaches that a desirable property of both donor and acceptor co-solvents used is a high dielectric constant. Such solvents generally promote dissociation of an ionic solute or a contact ion-pair (col. 14, lines 1-5). Example 1 of Chu teaches elemental sulfur, carbon black and polyethylene oxide in a solution of acetonitrile were mixed to form a slurry. The slurry was applied to a current collector to form the positive electrode. Figure 1 shows a lithium/liquid electrolyte/sulfur cell 10 having a positive electrode 18 with positive collector 20, a negative electrode 14 with negative collector 12, a separator 16 and a protective layer 8.

Thus the claims are anticipated.

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Claims 1-35 are rejected under 35 U.S.C. 102(e) as being anticipated by Katz et al., US 6,358,643.

Katz teaches a liquid electrolyte lithium-sulfur battery. It is generally desirably that the positive electrode have a relatively high porosity, possibly as high as 95% or more. Generally, higher porosity electrodes allow fabrication of cells with higher laminate energy densities because less electronic conductor is required. Of course, an electrode's porosity, capacity and thickness are linked so that setting two of these parameters fixes the other.

Note Chu et al., US 6,030,720 is incorporated by reference in Nimon (col. 6, lines 26-29). See discussion of Chu above regarding claims 1-33.

Thus the claims are anticipated.

Response to Arguments

Applicant's arguments filed 10/17/03 have been fully considered but they are not persuasive.

35 U.S.C. 112, second paragraph

Applicant argues that certain solvents belonging to both the weak polar solvent group (WPS) and the lithium protection solvent (LPS) group does not cause indefiniteness. Applicant states that if a solvent is selected that belongs to both the WPS and the LPS then the second solvent must be selected from the strong polar group to have solvents from at least two different groups. Examiner disagrees because if one selected two solvents that are termed WPS, they can also be considered LPS and "two or more solvents selected from the same group". Thus, the claimed groups are indefinite because each group is not clearly distinguishable from the remaining groups.

35 U.S.C. 102(e)

Regarding Chu et al., US 6,030,720, the reference is not limited to any preferred embodiment. The main solvent may be one or more of lithium coordinating ionophores (podands such as glymes, coronands such as crown ethers or cryptands) (col. 14, lines 33-55). Furthermore Chu teaches the liquid electrolyte solvent includes "about 50 to 100% by weight of the main solvent". The disclosure of "about 50%" includes values slightly below "50%", thus the claim limitation "less than 50%" is still anticipated by Chu. Note this limitation has been rejected as containing new matter.

Regarding Nimon et al., US 6,225,002, Applicants arguments are not convincing for at least the reasons provided above regarding Chu et al. Applicant have not provided any specific arguments with respect to the Nimon reference.

Regarding Katz et al., US 6,358,643, Applicants arguments are not convincing for at least the reasons provided above regarding Chu et al. Applicant have not provided any specific arguments with respect to the Katz reference.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tracy Dove whose telephone number is (703) 308-8821. The Examiner may normally be reached Monday-Thursday (9:00 AM-7:30 PM). My supervisor is Pat Ryan, who can be reached at (703) 308-2383. The Art Unit receptionist can be reached at

(703) 308-0661 and the official fax numbers are 703-872-9310 (after non-final) and 703-872-9311 (after final).

December 31, 2003

Patrick Ryan
Supervisory Patent Examiner
Technology Center 1700